CLAIMS

1. A diffractive optics system, comprising:

a directing element that directs an inputted optical signal;

means for repeatedly transmitting and diffracting the directed optical signal into multiple channels of distinct wavelengths; and

a reflector that receives the multiple channels from the means for repeatedly transmitting and diffracting and reflects the multiple channels back toward the means for repeatedly transmitting and diffracting.

2. A diffractive optics system as defined in claim 1, wherein the multiple channels that are reflected by the reflector are transmitted through the means for repeatedly transmitting and diffracting.

3. A diffractive optics system as defined in claim 1, wherein the multiple channels are transmitted through the means for repeatedly transmitting and diffracting at least two times.

4. A diffractive optics system as defined in claim 1, wherein the directing element includes a bi-convex lens.

5. A diffractive optics system as defined in claim 1, wherein the reflector is chosen from the group consisting of mirrors and retroprisms.

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6. A diffractive optics system as defined in claim 1, wherein the means for repeatedly transmitting and diffracting is angled with respect to directing element and the reflector.

7. A diffractive optics system as defined in claim 1, wherein the means for repeatedly transmitting and diffracting comprises:

a first diffractive optical element; and

a second diffractive optical element positioned at an angle with respect to the first diffractive optical element.

8. A diffractive optics system as defined in claim 7, wherein the first and second diffractive optical elements comprise binary transmission gratings.

9. A diffractive optics system as defined in claim 7, wherein the second diffractive optical element is attached to the reflector.

10. A diffractive optics system as defined in claim 1, further comprising a waveguide array that includes at least one input waveguide that directs the inputted optical signal toward the directing element, the waveguide array further including at least two outlet waveguides that are positioned to receive the multiple channels from the means for repeatedly transmitting and diffracting.

11. A diffractive optics system as defined in claim 1, wherein the system is capable of multiplexing multiple channels into a combined an optical signal.

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12. In an optical device, a diffractive optics system, comprising:

a waveguide array including an input fiber that directs an optical signal into the diffractive optics system;

a directing element that directs the optical signal;

a first diffractive optical element ("DOE") positioned to perform a first diffraction of the optical signal;

a second DOE positioned in an angled configuration with respect to the first DOE to perform a second diffraction of the optical signal; and

a reflector positioned to reflect the twice-diffracted optical signal back toward the second DOE.

13. A diffractive optics system as defined in claim 12, wherein the twice-diffracted optical signal is reflected by the reflector such that it passes through the first and second DOEs.

14. A diffractive optics system as defined in claim 12, wherein at least a portion of the waveguide array is positioned proximate a focal plane of the directing element.

15. A diffractive optics system as defined in claim 12, wherein the first and second DOEs comprise transmission diffraction gratings, and wherein the optical signal is transmitted through the first and second DOEs during the first and second diffractions.

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16. A diffractive optics system as defined in claim 15, wherein the first and second DOEs are selected from the group consisting of binary diffraction gratings, holographic diffraction gratings, surface-relief diffraction gratings, and computer-generated holograms.

17. A diffractive optics system as defined in claim 12, further including a polarization dependent loss prevention assembly interposed between the directing element and the first DOE.

18. A diffractive optics system as defined in claim 17, wherein the polarization dependent loss prevention assembly comprises a birefringent element and a ½-wave plate.

19. A diffractive optics system as defined in claim 12, wherein the directing element, first DOE, second DOE, and reflector are positioned in a folded arrangement such that they are angled with respect to one another.

20. A diffractive optics system as defined in claim 12, wherein the optical device is selected from the group consisting of a wavelength division multiplexing/demultiplexing device, an add/drop multiplexer, and a spectrum analyzer.

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21. A method of demultiplexing an optical signal, comprising:

directing a multiplexed optical signal along a predetermined path;

performing a first diffraction of the multiplexed optical signal to separate the multiplexed optical signal into a plurality of channels having distinct wavelengths;

performing a second diffraction to further disperse the plurality of channels;

reflecting the plurality of channels after the second diffraction; and

outputting the plurality of channels to a plurality of waveguides

22. A method of demultiplexing as defined in claim 21, wherein the first and second diffractions are respectively performed by a first transmissive diffraction grating and a second transmissive diffraction grating.

23. A method of demultiplexing as defined in claim 22, further comprising:

after reflecting the plurality of channels, transmitting the plurality of channels through the first and second DOEs.

24. A method of demultiplexing as defined in claim 21, wherein outputting the plurality of channels further comprises:

outputting the plurality of channels into discrete fiber optic waveguides positioned in a waveguide array.

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25. A diffractive optics system capable of multiplexing and demultiplexing optical signals, comprising:

a waveguide array including a plurality of fiber optic waveguides capable of carrying optical signals;

a lens assembly for directing optical signals;

a first transmissive diffraction grating positioned in series with the lens assembly;

a second transmissive diffraction grating positioned in series with the first transmissive diffraction grating; and

a reflector positioned in series with the second transmissive diffraction grating, the reflector enabling optical signals that have passed through the first and second transmissive diffraction gratings to be re-transmitted through the first and second transmissive diffraction gratings.

26. A diffractive optics system as defined in claim 25, wherein the first and second diffraction gratings comprise binary transmissive diffraction gratings.

27. A diffractive optics system as defined in claim 26, wherein the first and second transmissive diffraction gratings are angled with respect to one another.

28. A diffractive optics system as defined in claim 27, wherein the lens assembly and the reflector are angled with respect to the first and second transmissive diffraction gratings.

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29. A diffractive optics system as defined in claim 28, wherein passage of an inputted optical signal through the system demultiplexes the optical signal into a plurality of wavelength-distinct channels.

30. A diffractive optics system as defined in claim 28, wherein passage of a variety of wavelength-distinct optical signal channels through the system combines the optical signal channels into a multiplexed optical signal.

31. A diffractive optics system as defined in claim 28, wherein the lens assembly, the first and second transmissive diffraction gratings, and the reflector are positioned in a telecentric mode.

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